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Research Briefs

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Nutrition and Health

A hormone-like substance called thromboxane could someday join cholesterol as a risk indicator for heart disease. A study of 40 volunteers—the largest of its kind—confirms that certain fats in fish oil help hold thromboxane to healthy levels in arteries. Released by blood platelets, thromboxane helps to regulate arterial blood flow. It also encourages the platelets' blood-clotting function. But, just as too much cholesterol in an artery is like sludge clogging a hose, too much thromboxane constricts the hose—raising blood pressure and heart disease risk. Excess thromboxane also tends to increase unwanted blood clotting in an artery. For part of the 28-week study, the volunteers got a daily 15-gram supplement of fish oil in their controlled diet. Result: they excreted at least 15 percent less of a thromboxane byproduct in their urine, indicating that their platelets released less thromboxane. Researchers plan future studies to see how fish oil and other fat sources affect the ratio of thromboxane to its counterpart, prostacyclin, which dilates arteries and hinders blood clotting.

Beltsville Human Nutrition Research Center
Beltsville, MD

Aldo Ferretti, (301) 504-8306

An unlikely combination of insulin and miniature cattle may help scientists clear up some of the mysteries surrounding dwarfism in humans as well as cattle. The

studies are aimed at determining the role that insulin and related hormones play in the growth of livestock. In tests, insulin injections partially reversed some of the hormone abnormalities associated with a type of dwarfism in Brahman cattle that is similar to Larun, a dwarfism in humans. Both types are diabetes-like conditions caused by below-normal blood levels of a hormone, called insulin-like growth factor-1. The injections stimulated the cow's cells to produce the growth factor. Further tests on the cattle may lead to a better understanding and ultimately to a treatment for human dwarfism. The tests were part of a cooperative study conducted with scientists from the University of Florida in Gainesville.

Ruminant Nutrition Lab, Beltsville, MD
Theodore H. Elsasser, (301) 504-8281

Skimping on vitamin C lowers the body's concentration of another compound important for good health. Scientists with ARS and the University of California at Berkeley and Los Angeles ran a 13-week investigation with 8 male volunteers to learn more about effects of low intakes of vitamin C. When the men consumed less than one third the Recommended Dietary Allowance of vitamin C—which is 60 milligrams—their glutathione levels fell 50 percent. Glutathione helps guard against heart disease, cancer and inflammatory diseases such as arthritis. When the volunteers raised their vitamin C intake, glutathione increased. It's known that a low intake of vitamin C weakens the body's disease defenses. But the new study is apparently the first to show that lowering glutathione is another path by which a low-C regimen impairs defenses. Fruits and vegetables are good sources of the vitamin, especially strawberries, kale, broccoli, citrus fruits and green peppers.

Western Human Nutrition Research Center
San Francisco, CA
Robert A. Jacob, (415) 556-3531

Extra vitamin C at each meal can help women get more iron from the less available sources—vegetables, grains and legumes. In a 10-week study, women of childbearing age ate a diet very low in meat and high in plant foods from which iron is harder to absorb. During half the experiment, they got a 500-milligram vitamin C supplement with each meal; during the other half, a placebo. The supplement didn't increase either blood hemoglobin or iron reserves, but it significantly boosted the active thyroid hormone, T3. Studies with rats have shown that iron deficiency reduces

levels of T3, which regulates the body's metabolism. The results support findings from earlier studies showing that vitamin C can enhance iron absorption from plant foods. Getting enough iron has long been a problem for younger women and may be becoming more so among those who cut back on consumption of red meat. Adding a glass of orange or grapefruit juice or a serving of fresh strawberries or broccoli to meals can help overcome the problem.

Grand Forks Human Nutrition Research Center

Grand Forks, ND

Janet R. Hunt, (301) 795-8328

The body's metabolism works double time on Mt. Everest, where oxygen is one-half to one-third that of sea level and temperatures plunge well below zero. During a 9-week study on the mountain, 10 climbers burned an average 5,148 calories per day to maintain body temperature and perform their tasks at altitudes up to 29,000 feet. Four of the climbers actually burned between 6,000 and 8,000 calories daily. By contrast, a marathoner burns about 3,200 to 3,400 calories on race day. The figures would be substantially higher on climbing days, since the climbers rested for one or more days in between. Five others who remained at the 17,500-foot elevation base camp to run the testing lab burned an average 3,286 calories per day. That's equivalent to running a marathon every day. Despite the energy toll, climbers ate only about half of the calories they burned on an average daily basis; base-campers ate about 60 percent. Everyone returned home thinner, but not as thin as their reported intakes would suggest. Climbers averaged a 13 percent loss of body weight, and base-campers averaged a 10.4 percent loss compared to losses up to 30 percent reported by other expeditions. It appears that this team ate better than most, probably because great care was taken to select foods that were tasty and easy to prepare.

... The 1989 expedition study was coordinated by a former ARS nutrition researcher and climbing enthusiast to determine what types of foods may improve performance and reduce physical and mental trauma under such harsh environmental conditions. Team members selected foods from a high-fat or low-fat diet (40 percent of total calories vs 20 percent) that they felt gave them the most comfort or the feeling of optimum performance. As a group, the 15 men and women surprisingly averaged only 30 percent of calories as fat, even though extra fat would have provided more calories. Individually, fat intake ranged from 23 percent to 40 percent. Carbohydrates contributed 52 percent of the team's average daily calories, ranging from 41 to 60 percent on an individual basis. The low oxygen at these altitudes may have triggered their desire for lower fat foods because it takes less oxygen to derive energy from carbohydrates than from fat.

*Beltsville Human Nutrition Research Center
Beltsville, MD*

M. Patricia Howard, (301) 344-2459

University of Illinois at Chicago

Robert D. Reynolds, (312) 996-1207

A closer look at blood platelets could lead to a new test to determine which fats in the diet raise or lower the risk of heart disease. Platelets' main job is to halt bleeding. Imagine them beginning as empty balloons, which then become inflated, grow spikes and interlock with other spiky, swollen platelets. Heart disease is linked to "hyperactive" platelets—too many are round and swollen. In this form, they increase unwanted clotting and impede normal blood flow within an artery. The new approach measures the platelets' change toward roundness from a disc-like, unactivated form, which promotes blood flow. ARS scientists pursued the platelets' change after an intriguing finding from a 28-week diet study of 40 human volunteers. Fish oil fats in the diet, they found, increased the proportion of disc-like platelets. In a follow-up study with rats, scientists saw similar effects. They also determined the best conditions for collecting platelet samples. Studies of platelet activation in lab animals and human volunteers could help nutritionists and physicians design more healthful diets, especially for people at higher risk of heart disease, diabetes and other chronic ailments.

*Beltsville Human Nutrition Research Center
Beltsville, MD
Norberta Schoene, (301) 504-8306*

Women who have lost their get-up-and-go may be suffering from low iron reserves, even though standard blood tests don't indicate anemia. Findings of a rat study have implications for at least 20 percent of U.S. women of childbearing age who test low for iron reserves (the iron not associated with blood hemoglobin). The animals that got a low-iron diet were significantly less active in the dark—when rats are normally most active—than the group getting adequate iron throughout the 2-month study. While tests for hemoglobin and hematocrit levels were normal in the low-iron group, iron reserves (non-heme iron) were below normal. In people and animals, hemoglobin and hematocrit are the last numbers to slip when iron intake is inadequate because the body will deplete its reserves to maintain its oxygen-carrying capacity.

*Grand Forks Human Nutrition Research Center
Grand Forks, ND*

Janet R. Hunt, (701) 795-8328

A zinc-deficient diet may interfere with male fertility in a relatively short time, according to a study of 11 men. They consumed 5 different levels of zinc, ranging from 10 percent of the Recommended Dietary Allowance to 70 percent. The RDA is 15 milligrams per day. After 5 weeks of getting only 10 percent of the RDA, semen volume dropped one-third and blood testosterone levels one-fifth, compared to when the men were getting 70 percent. Since the concentration of zinc in semen didn't change throughout the study, the body apparently tries to hold on to dwindling supplies of the mineral by reducing the volume of ejaculate. However, a diet with so little zinc is far from typical. The study diet contained little of the good sources of zinc—

meat (particularly beef), whole wheat products, nuts and legumes, oysters and other shellfish. On average, U.S. men get about 85 percent of their zinc RDA, which is considered adequate for most men.

*Grand Forks Human Nutrition Research Center
Grand Forks, ND
Curtiss Hunt, (701) 795-8423*

Cows make a chemical cousin of vitamin D that may help relieve certain human disorders, such as osteoporosis, psoriasis and kidney disease. Its chemical structure is similar to compounds—some related to vitamin D—being used in experimental treatment of these diseases. While studying vitamin D and its role in preventing costly cattle diseases like milk fever and mastitis, ARS researchers identified and isolated the hormone, which cows make from vitamin D. It has the tongue-twisting name of 1 α ,24-dihydroxy ergocalciferol. A Madison, WI, pharmaceutical firm has applied for a license to use the new compound as a possible preventative for the human diseases.

*National Animal Disease Center, Ames, IA
Ronald L. Horst, (515) 239-8312*

An iron-binding protein found in human breast milk may do more than protect infants' intestinal tracts against infection. That's one known role of lactoferrin, which literally means "milk iron." It is not currently added to infant formulas in the United States. Now, researchers have found that a significant portion of the lactoferrin fed to premature infants ended up in their urine—intact. This larger than average protein survives absorption through the intestinal wall, circulation in the blood, and filtration through the kidneys instead of being broken down into amino acids. The researchers speculate that it may be involved in regulating the development and function of infection-fighting cells in infants because it is also found in immune cells of adults. They are working to identify all human milk proteins that serve as more than building blocks in order to design infant formulas that mimic mother's milk.

*Children's Nutrition Research Center, Houston, TX
T. William Hutchens, (713) 798-7053*

Nursing mothers would be wise to avoid calorie-slashing diets to lose the weight gained during pregnancy. Such diets may deprive them of the extra protein their bodies need to maintain muscle while producing breast milk. Ten nursing women recently studied were consuming 33 percent more protein than the current Recommended Dietary Allowance for lactating women. They lost less than 3 pounds on average in the six months after delivery. And none of that loss came from lean tissue. Earlier studies showed that getting only the recommended amount of protein puts nursing mothers in a protein deficit and suggested that some of their protein loss may be coming from muscle. Getting one-third more protein than currently

recommended, however, prevented a deficit and appears to be closer to the actual need. For a 140-pound woman, that translates to about 100 grams of protein per day. Healthy nursing mothers generally get ample protein. But dieters, low-income women and adolescents may be undercutting their needs. A cup of low-fat cottage cheese, 3 ounces of tuna white meat in water, or a 3.2-oz envelope of dried, non-fat buttermilk each provide about 30 grams of protein. *Children's Nutrition Research Center, Houston, TX
Kathleen J. Motil, (713) 798-7180.*

Tomorrow's Foods

Oatrim, a high-soluble-fiber modified oat flour designed by an ARS scientist to replace fat in foods, is now being produced by Conagra. Used as a powder or mixed with liquid to form a gel, oatrim can replace a major portion of shortening in breads, cookies, cakes and other foods. Conagra, one of three companies that obtained a license to make the patented flour, has been adding oatrim to extra-lean ground beef since last fall. In addition, the other two licensees, Quaker Oats Co. and Rhone-Poulenc Inc., have announced plans to make and sell oatrim. Oatrim is commercially available to food companies for use in meats, baked goods, bakery mixes, icings and fillings, extruded cereals and confections.

*National Center for Agricultural Utilization Research
Peoria, IL*

George E. Inglett, (309) 685-4011

Sunkist has commercialized an ARS process that easily separates the peel from oranges and grapefruit without marring the fruit or losing any juice or vitamins. ARS researchers developed and patented the easy-peel process that uses a mixture of pectinase and water to soften the pithy white albedo that binds the peel to the fruit. Peeled and chilled oranges and grapefruit have a shelf life of about 21 days. The technique allows fruit to be dispensed in individual, sealed plastic containers in vending machines in places such as health clubs and schools.

*Citrus and Subtropical Products Laboratory
Winter Haven, FL*

Robert A. Baker, (813) 293-4133

A new flavoring mix boosts the appetizing aroma of tomato soup, spaghetti sauce, salsa and other products from tomato paste or sauce. ARS scientists invented the blend while researching ways to improve fresh tomato flavor. One drop of this combination of seven natural tomato flavor compounds is enough to heighten the flavor of 20 one-quart jars of spaghetti sauce. Most of the ingredients are available from commercial sources. All but one are approved for food use. The mix, which has been patented,

can be encapsulated with gelatin to sprinkle on foods, or it can be combined with other seasonings.
Western Regional Research Center, Albany, CA
Ronald G. Buttery, (510) 559-5667

A domestic alternative to imported cocoa butter, the primary ingredient in chocolate, baked goods and other food and non-food products, could come from the action of a commercially available enzyme on a cottonseed oil and high-oleic sunflower oil. The United States imported 70 million kilograms of cocoa butter valued at \$211 million in the first nine months of 1991. The new product has about 90 percent of the functionality of pure cocoa butter. When mixed with cottonseed oil and sunflower oil, the enzyme rearranges the oils' fatty acids. The result is a product with many of the chemical and physical properties of natural cocoa butter. The process is less complicated than other enzyme processes, which use non-domestic oils, and yields a better product than those from non-enzyme processes.
Southern Regional Research Center, New Orleans, LA
George Abraham, (504) 286-4339

Leaner beef can result from increasing the amount of time that it takes for cattle to reach slaughter weight. Researchers fed identical diets to cattle of the same genetic type, but geared the diets so that the cattle would reach a designated carcass weight at different ages. The result: 22 percent of the variation in fatness was associated with number of days on feed. The researchers also fed different diets to steers raised to the same weight at the same age and found that an additional 28 percent of the variation in fatness could be attributed to nutritional factors.
U.S. Meat Animal Research Center, Clay Center, NE
John W. Keele, (402) 762-4251

Food Freshness and Safety

A shot of calcium means fewer rotten apples in the storehouse. With a pressure infiltration method, ARS scientists injected additional calcium into fruit after harvest. That reduced gray mold rot and bitter rot in apples by more than 50 percent. The fruit's level of maturity is the most important factor in determining how well this method will work, scientists say. Picked too soon, apples won't allow enough calcium to enter; picked too mature, they can be injured by letting in too much calcium. ARS and University of Tennessee researchers and a major packing facility are running a pilot test to determine the method's commercial feasibility.
Horticultural Crops Quality Lab, Beltsville, MD
William S. Conway (301) 504-6128

Computer signals turn on high-pressure water jets to remove bone, fat and gristle from beef chucks in a new, automated system for meat packing plants. ARS scientists use either electronic needles or optical or sonic sensors to detect the unwanted parts and relay the information to the computer. Water jets take out the parts as they move down a conveyor belt. Results: a higher quality product for restructured beef cuts that are used primarily in convenience and institutional foods such as TV dinners. This robotic system is five times faster than manually deboning and removing fat and gristle from beef chuck. It could lead to a savings of approximately \$1 million a year for the meat industry.

Eastern Regional Research Center, Philadelphia, PA
James Craig, Jr., (215) 233-6589

A hot-water bath may soon open new domestic and export markets for Florida guavas. Because the fruit is a major host of the Caribbean fruit fly, it cannot be shipped from Florida to other states or countries that don't have the pest. But ARS scientists have developed a hot water immersion treatment that kills the fly without damaging the fruit. In research trials, the method exceeds the required mortality rate for the fruit fly. Scientists are submitting the hot water quarantine method to state regulatory officials for approval. Currently, no pesticides are approved for use against this pest on guavas, nor is there an approved quarantine treatment.

Subtropical Horticulture Research Lab, Miami, FL
Walter P. Gould, (305) 238-9321

Tomato hornworms and corn earworms that plague gardeners and farmers were felled by a natural insect virus in lab tests. These crop pests are among more than two dozen species of pesky caterpillars attacked by the celery looper virus. Within 5 years, it might be available as a new, environmentally friendly insecticide. ARS researchers discovered the virus in the pale-green celery looper worm. The microorganism doesn't target people, pets or other forms of life. When eaten by a caterpillar, virus particles multiply and kill it within a few days. The worm's body then liquifies. What's left is a virus-infected fluid that oozes onto leaves or soil for other caterpillar pests to ingest. Outdoor experiments in three cotton-growing states this year will track the virus' ability to kill major caterpillar enemies of that crop. ARS scientists are working with Sandoz Agro, Inc., on the tests, under a cooperative research and development agreement.
Range Insect Control Research, Kimberly, ID
Donald L. Hostetter, (208) 423-6518
Horticultural Crops Research Laboratory, Fresno, CA
Patrick V. Vail, (209) 453-3000

The **Briefs** is published quarterly by ARS Information. For further information or addition to the mailing list, contact Judy McBride, nutrition editor, at (301) 504-8932; or write me at Bldg. 419, BARC-East, Beltsville, MD 20705.